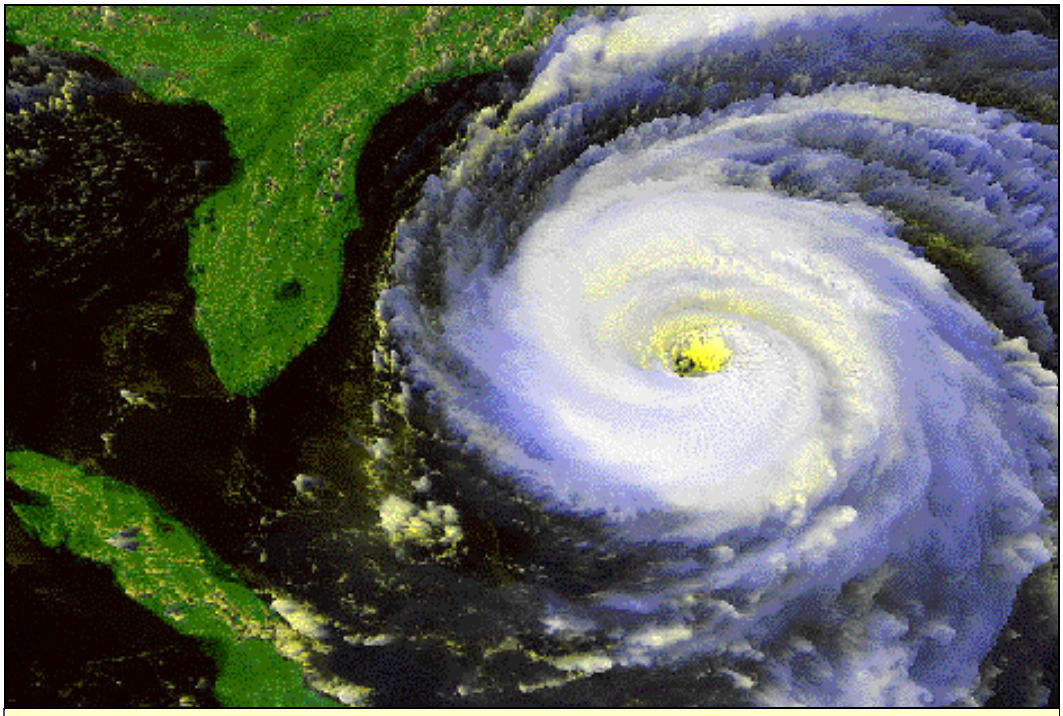
Insurance/Disaster Management

The insurance and disaster management industries are closely related -- both deal with the risk of natural disaster and managing the events following disasters. In the insurance industry, profit is tied to the ability to forecast the probability of natural hazards, including storms, blizzards, and floods. The extreme losses incurred as a result of Hurricane Andrew in Florida ($16 billion) point to the importance of understanding the climate system and quantifying long-term trends in storminess, temperature, and aridity. Similarly, state and local governments need to identify zones particularly susceptible to natural hazards to aid in local development and the allocation of emergency resources. Although humans cannot stop natural disasters, careful risk analysis can help save lives and reduce monetary damages.

In addition to these long-term roles, both industries are responsible for rapid response in the days following disaster. While the insurance industry handles short-term claims assessment following a natural disaster, disaster response is generally handled by state and local governments, which require timely data on the geography of affected regions and infrastructure condition to efficiently deploy emergency resources.



This image of Hurricane Fran, taken from the NOAA/National Weather Services' GOES-8 satellite in September 1996, was enhanced and rendered at the NASA Goddard Space Flight Center, Laboratory for Atmospheres, Greenbelt, MD. Improved short-term forecasting of hurricanes and other severe weather events is a likely result of assimilation of Earth Science Enterprise data into climate models.

Data and information derived from NASA's ESE will aid risk assessment, prediction of long-term climate variability, and short-term event monitoring. These instruments contribute near daily observations over the entire globe at a moderate spatial resolution. Over decades, the trends illuminated by these data will allow more complete characterization of long-term climate and climate change, thus making long-term risk assessment easier. To fully exploit the strengths of remote sensing for short-term disaster management, ESE data could be integrated with available GIS data containing detailed, local information, such as street name, utility plans, and zoning. Then, ESE data could aid in daily monitoring of local conditions and rapid response to emergencies.

A discussion of current and potential uses of satellite remote sensing data for insurance and disaster management follows. In the Insurance / Disaster Management Applications Matrix, the rows correspond to specific applications, and the columns correspond to individual ESE instruments. The potential use of data from a given ESE instrument to a specific insurance / disaster management application is denoted by a check mark in the matrix.

Insurance/Disaster Management Applications Matrix

Application	ESE Instrument													
	MODIS	ASTER	Landsat 7	MISR	CERES	AMSR TMI	PR	EOS Models	SRTM	Sea WiFS	Sea Winds	AMSR	AIRS/ AMSU/ MHS	GLAS
A. Hazard Assessment/Risk Exposure														
1 Hydrologic Modeling of Flood Prediction	✓					✓	✓	✓	✓	✓		✓		
2 Monitoring Land Use/Land Condition Change	✓	✓	✓	✓						✓				
3 Landslide Probability	✓	✓	✓			✓			✓	✓		✓		✓
4 Forecasting Severe Storms	✓				✓	✓		✓		✓	✓	✓	✓	
5 Predicting Weather and Climate	✓				✓	✓	✓	✓			✓	✓	✓	
B. Damage Impact Assessment														
6 Floods	✓	✓	✓							✓				
7 Landslides		✓	✓							✓				
8 Avalanche		✓	✓							✓				
9 Volcanic Eruption	✓	✓	✓	✓						✓	✓			
10 Drought/Crop Failure	✓	✓	✓	✓	✓	✓	✓	✓		✓				
11 Beach Erosion/Shoreline Change		✓	✓							✓				
12 Pollution Retrodiction	✓	✓	✓							✓	✓			

A. Hazard Assessment/Risk Exposure

This category covers all applications that have primary benefit before the occurrence of a natural disaster, either through improved short-term hazard forecasting or long-term statistical analysis of risk.

1 Hydrologic Modeling of Flood Prediction
2 Monitoring Land Use/Land Condition Change
3 Landslide Probability

Although floods, landslides, and fires are unpredictable events, some observable warning signs in the physical condition of the land can be monitored by satellite. With accurate, timely disaster warning, short-term prediction (e.g., days to weeks in advance) of flooding would permit proper allocation of emergency response teams and allow residents to prepare, thus reducing loss of life and damage to property. Similarly, frequent land cover mapping allows numerous conditions to be monitored, including forest fire, landslide, and flooding hazards. Insurance companies could thus better estimate future claims, institute additional hazard protection, and potentially minimize losses.

Insurance/Disaster Management

Landsat images, such as the one shown here of the St. Louis area, have been widely used to determine the extent of floods, and other changes to river systems.

ESE satellite observations can play a major role in identifying precursors to natural disasters. For example, floods can currently be forecast via numerical hydrologic models. Observations from MODIS, AMSR, and TMI will provide data for atmospheric models, allowing more accurate prediction of local precipitation. In addition, the AMSR and TMI passive microwave instruments will measure soil moisture directly to help predict runoff, subsurface flow, and flooding.

Similarly, most landslides are caused by long-lived, heavy precipitation in regions with steep slopes and inadequate land cover. Land use and condition can be readily mapped from satellites in the visible and near-infrared spectrum. The MODIS, ASTER, Landsat 7, and MISR instruments together will provide high resolution, daily multispectral images of vegetation and land cover over the entire globe. Continuous monitoring of soil moisture with TMI and AMSR data, combined with land use mapping from the VNIR satellites, can be integrated with GIS databases to provide both long-term hazard assessment and improved short-term landslide prediction.

4 Forecasting Severe Storms

Hurricanes and severe storms represent a major source of risk for the insurance industry. For example, the value of insured properties in the coastal areas of the Atlantic and Gulf regions susceptible to hurricanes exceeds $2 trillion. ESE data on surface temperature, atmospheric water vapor, oceanic winds, and cloud cover and composition input into 4-dimensional atmosphere-land-ocean data assimilation models will result in improved short-term forecasts so that residents can minimize personal and property damage before severe storms. In addition, local governments will be better able to allocate resources and deal with the results of severe weather.

5 Predicting Weather and Climate

In addition to forecasting individual emergency management and local episodes of severe weather, it is valuable to evaluate the long-term trend of climate change and offer long-term predictions of climate conditions around the globe. For example, during recent El Nino/ENSO events, Southern California has experienced severe storms, land slides, and coastal erosion. Concurrently, Australia, Indonesia, and Peru experienced severe droughts. Better predictions would

have offered improved risk assessment for the insurance industry and allowed the local governments to make advanced preparations.

A specific ESE goal is to better understand the global climate and to quantify the effects of climate change. Numerical models are currently being developed to improve long-term prediction, but they lack global data to constrain model forecasts. By collecting simultaneous observations of atmospheric, oceanic, and land parameters over the globe, the ESE program will substantially improve future model results.

B. Damage Impact Assessment

This category includes applications important during and immediately after a natural disaster; the emphasis is on monitoring after effects.

6 Floods
7 Landslide
8 Avalanche
9 Volcanic Eruption

Once a natural disaster occurs, it is critical to assess conditions as quickly as possible, to plan and execute the emergency response, to minimize the degree of damage, and to save lives. In addition, insurers can obtain a rapid picture of where damage has occurred and the relative severity of damage, thus expediting claims processing.

ESE instruments with high spectral resolution will support disaster response. Flood extent can be monitored through ASTER, Landsat 7, and MODIS data. Similarly, landslides, avalanches, and infrastructure collapse may be mapped from space. The effects of volcanic eruption, for example, may be monitored in two respects: the atmospheric plume can be tracked visibly with any of the visible / near-infrared instruments, and high resolution sensors can image lava flows and mud slides associated with eruptions. In particular, ASTER features high spatial resolution and sensitivity to the thermal infrared region (temperature), making it ideal for tracking hot mud and lava.

10 Drought/Crop Failure

Crop failure represents a risk for local economies and insurance companies. ESE instruments provide several mechanisms for monitoring the health of crops and forecasting yields. First, MODIS is extremely sensitive to chlorophyll and can provide estimates of evapotranspiration and leaf-area index, which are indicative of plant health. Along with other visible / near-infrared imagers, MODIS can provide vegetation indices that can be correlated directly with harvest yields. Finally, observations of cloud cover / cloud thickness data and soil moisture and rain-rate data can help identify regions around the globe experiencing drought conditions.

11 Beach Erosion/Shoreline Change

Beach erosion is a major financial hazard for property owners and their insurers. Changes in beach shape and extent can be monitored directly from high-resolution imagers such as ASTER and Landsat 7. Over the lifetime of the ESE program, a high-resolution time series of beach conditions will be generated. Insurance companies will be able to draw upon to improve risk assessment.

12 Pollution Retrodiction

Assigning responsibility for oil and chemical spills requires identifying the source of the contamination. Satellite data has proven useful for this task. Hydrocarbons (oil), for example, have a distinct signature in the thermal infrared region and can be mapped as slicks or plumes in open water or rivers. MODIS will provide daily coverage and high spectral resolution, enabling rapid identification of spreading contamination.